INFORMATION AND THE FUTURE OF BATTLE COMMAND

A MONOGRAPH
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ABSTRACT

INFORMATION AND THE FUTURE OF BATTLE COMMAND
By Major Karen L. Sinclair, 40 pages.

The purpose of this monograph is to examine information flow and problems at battalion and brigade levels and how it effects battle command. The primary research question is: Will the digitization of the battlefield and the resultant information dominance effect battle command at the brigade and battalion levels? This monograph concludes that the digitization is not alleviating the problems with information management experienced at brigade and battalion levels.

This monograph examines the current issues with information flow at brigade and battalion levels by studying observations from the National Training Centers and experiences during Desert Storm. The monograph studies how commanders and staffs process information and the resultant effects on decision making. The monograph briefly studies the current digitization initiatives and tries to determine their impact on information processing.

Digitization and increased technology provide the commander and staff with an exponential increase of information. It is critical that the commander identify what information he needs in order to make decisions or change his vision of the battlefield. Improvements in information processing will not alleviate uncertainty on the battlefield. Technology will not take the art out of battle command.

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Introduction

Throughout history, the advent of new technologies and their application on the battlefield changed the nature of warfare. From the development of precise rifled weapons to the addition of air power, modern armies and doctrine have adapted in response to the new technologies. Advanced weaponry caused dispersion on the battlefield. No longer could a commander view and command and control the entire battle from a nearby hilltop. As a result, command and control (or battle command) of these dispersed forces became more complex. The application of the telegraph, telephone and radio for military purposes aided commanders in their battle command efforts. Currently, the United States Army is looking at information technology to change the nature of battle command of the future battlefield.

Information technology is a rapidly developing science. Within the first decade of the 21st century, information technology is expected to make a thousand-fold advance. These developments are expected to change how nations, organizations and people interact.[1] On the modern battlefield, these developments are also expected to provide information dominance and greater situational awareness thereby decreasing uncertainty for the commander.

Will the digitization of the battlefield and the resultant information dominance effect battle command at

brigade and battalion levels? The function of acquiring and communicating information as it relates to battle command is currently a significant problem at battalion and brigade levels. At the U. S. Army Combat Training Centers (CTC), brigades and battalions experience problems with information management. Only when commanders and staffs are able to efficiently manage information can they effectively function. This management of information in no easy task considering the volumes of information which passes through a battalion or brigade Tactical Operations Center each day.[2] Staffs must be able to acquire and communicate the pertinent information to aid the commander in his visualization of the battlefield.

The advent of Force XXI, hence the increased digitization of the battlefield, will bring more information and information processes to the commanders and staffs on the future battlefield. Will the application of improved technology solve the problems of information overload and information pathology that brigade and battalion commanders experience today? Or will the increased processing of information capabilities be self-defeating as Martin Van Creveld claims in Command in War?[3] How does the Army define information dominance and battle command?

In preparation for the Information Age, the Department of the Army recently published new doctrine for information

operations, Field Manual 100-6. Heretofore, this written doctrine did not exist although information operations are not new. Simply stated information operations are friendly actions to gain information and knowledge in order to aid in the execution of operations while hindering the enemy's information gathering capabilities.[4] In order to gain an advantage on the modern battlefield, commanders must achieve information dominance at the right place and time and be able to exploit this dominance. Field Manual 100-6 defines information dominance as:

> "the degree of information superiority that allows the possessor to use information systems and capabilities to achieve an operational advantage in a conflict or to control the situation in operations other than war while denying those capabilities to the adversary."[5]

A commander secures information dominance by having a knowledge advantage over opposing forces. Field Manual 100-6 likens information dominance to air power. A commander can achieve a level of knowledge advantage from information supremacy to information parity.[6]

Battle command is intrinsically linked with information and information processing by the commander. Current United States Army operations doctrine, Field Manual 100-5, recognizes the information challenges that leaders confront on the modern battlefield. A commander must digest an abundance of information in order to visualize the battlefield, make an accurate assessment of the situation,

and then direct action in order to attain victory.[7] Field Manual 100-5 defines battle command as:

> "the art of battle decision making, leading, and motivating soldiers and their organizations into action to accomplish missions. Includes visualizing current state and future state, then formulating concepts of operations to get from one to the other at least cost."[8]

General (Retired) Frederick Franks makes a distinction between command and control and battle command.[9] He feels that command and control focuses more on staff processes and a Cold War mentality. However, battle command focuses on the art of command not the science of control and on leadership in battle. With the developments of information technology, battle command is undergoing a metamorphosis.[10]

In order to determine the effects of the increased digitization of the battlefield and the resultant information dominance will have on battle command at brigade and battalion levels, this monograph will examine four questions. What are the current issues with receiving, distributing, and analyzing information as it relates to battle command at brigade and battalion level? How do commanders and staffs process information and how does this effect decision making? What will increased digitization of the force do to information and what information management tools will it bring for battle command? Will digitization of the battlefield solve or exacerbate current information issues at brigade and battalion level?

Information Issues and Battle Command

Information or data which has been collected and processed into a usable form[11] can be a valuable commodity to the commander. Field Manual 100-6 discusses the cognitive hierarchy and the role that information plays in it. At the bottom of the pyramid is data. Data by itself is usually without meaning. Once it is processed and placed into a situational context it transforms into information. Once the information has been tested and accepted as fact, it becomes knowledge. Commanders use this knowledge within context of the situation to make judgments or decisions and come to an understanding of the situation. This understanding aids the commander in his visualization of the battlefield and in his determination of intent and concept of an operation. Commanders must be ready to make decisions without complete understanding of the situation because not all information received is valuable.[12]

Information is only valuable if it possesses certain qualities. Information needs to be pertinent to the current situation.[13] Information about future operations or phases is good to know but may not be relevant to the current fight. Information needs to be correct.[14] In the cognitive hierarchy, information is tested or analyzed to prove the

information. Once it is accepted as factual it becomes knowledge. Obviously, decisions based on inaccurate information can lead to faulty plans and potential disaster for friendly forces. Information needs to be received and processed in a timely manner.[15] Decisions based on old information or information that has drastically changed can again lead to faulty plans. Information pathology is prevalent at brigade and battalion tactical operations centers.

Information needs to be in a form which is usable by the commander.[16] Depending on the individual commander's needs this usable form can vary. Some commanders are visually oriented and need a picture to comprehend the situation. Others can gain understanding through words or numbers. It is the responsibility of the commander to convey to his staff his information needs. It is the responsibility of the staff to understand these needs and put the information into a usable form. Furthermore, the information needs to be easily accessible. If a commander must go throught a 20 page report to get the information he needs, time is wasted and necessary decisions may be delayed.

Information needs to be in the right amount.[17] The right amount can vary with the situation. Enough information must be received in order to make a decision

with the conviction that it is the best decision given the situation. Too little information or the absence of critical information can lead to bad decisions or plans. The converse is true as well. A commander or staff can be so overloaded with information that it is difficult to determine what information is critical and what information is just routine, to assimilate that critical information and make a decision. The decision-making process can literally be stagnated or paralyzed by too much information.

Tactical operations centers are the focal point for information at brigade and battalion levels. Current doctrine does little to delineate the functions of a TOC. The Center for Army Lessons Learned published a newsletter solely about TOCs[18]. Within this newsletter, the Center for Army Lessons Learned outlines six basic functions. Four of these six functions deal with information and information management. One function of a TOC is to receive information. This information includes messages, reports, and orders from higher headquarters and from subordinate units. This function also entails monitoring the tactical situation, maintaining a journal of all significant activities and reports, maintaining and updating unit locations and activities, monitoring the enemy situation and maintaining a status of the critical classes of supply.[19]

Another function of the TOC is distribution of information to higher headquarters, subordinate units and laterally to sister units. TOCs submit reports to higher headquarters, relay information between units, disseminate orders and instructions, and process and distribute information to the appropriate unit and staff sections.[20]

One of the major functions of the TOC is to analyze the information they receive. This analysis includes conducting predictive analysis based on the tactical situation, anticipating events and executing the appropriate actions, if required. TOCs must recognize information that corresponds to the commander's critical information requirements (CCIR). Concurrently, staffs must conduct the tactical decision making process based on information received and identify and execute contingency plans based on the situation. The remaining TOC function that directly involves information is to provide recommendations to the commander based on information received and the subsequent analysis. [21]

The failure in the execution of these TOC functions caused units problems at the Combat Training Centers and during Desert Storm. A study of Combat Training Center trends from fiscal years 1994 through 1996 at brigade and battalion level reveals several issues related to information and information management. The Center for Army

Lessons Learned (CALL) collects and analyzes field data from the National Training Center, the Joint Readiness Training Center, the Combat Maneuver Training Center and the Battle Command Training Program. Each quarter, CALL publishes a trends bulletin which focuses on problem areas and performance trends from the CTCs with non-attribution to specific units. Perhaps the most prevalent problem is battle tracking in all of the battlefield operating systems. Effective battle tracking includes handling of basic message traffic, display of information, and identification of what information to track. Battle tracking entails following the situation of both friendly and enemy forces including size, location, capabilities, intent, activities and logistical status. How a unit tracks the battle during fast paced operations separates the functional tactical operations center (TOC) from the dysfunctional tactical operations center.[22]

At the Combat Training Centers, during slow paced operations, TOCs were fairly efficient at receiving, processing and distributing information. However during fast paced operations, TOCs received so much information that it became almost impossible to process each piece of information.[23] TOCs were quickly overwhelmed with information. Furthermore, not all of this information is critical to the current situation. Frequently, TOCs failed

to keep essential maps, unit locations, and combat power status up to date. Battalion TOCS were not tracking subordinate units down to the appropriate level. TOCs rarely tracked locations of non-organic and adjacent units. The battlefield operating systems sections rarely tracked or posted their respective unit locations. TOCs failed to adequately disseminate critical information such as minefield locations to the appropriate units. Not all staff sections in the TOC displayed the same information and the information displayed was not consistent throughout the staff sections. Crosstalk among the staff sections was not apparent. Operations and intelligence sections displayed different enemy information.[24] Commanders could not go to one focal point in the TOC to get a quick and accurate snapshot of the battle.

During fast paced operations, one of the first and perhaps the most important function to be degraded was the analysis of information. TOCs were concerned with merely relaying information to higher headquarters and failed to conduct an analysis of the information. Without adequate analysis of the information received, TOCs were unable to provide their commanders with estimates of likely enemy actions. They were also unable to provide their commanders recommendations of possible future friendly courses of action. Without the analysis of the information, the staff

has failed the commander. They have neglected to paint the picture of the battlefield for the commander. Without a clear or fairly accurate picture, the commanders were hard pressed to make necessary decisions.[25]

Tactical operations centers experience information and information management problems not only during training scenarios but during actual missions. TOCs experienced issues with information and information management during Desert Shield/Desert Storm and Operation Joint Endeavor in Bosnia-Herzegovina. Never before had the Army deployed with so much information technology and computer systems to facilitate accomplishment of the mission. During Desert Shield/Desert Storm, computers were used at all levels and for many functions to include maintaining a database on unit and personnel movements and enemy electronic order of battle, analyzing intelligence, management of air defense and artillery, management of frequencies and the production of the daily air tasking order.[26] Perhaps the most well known technology used during Desert Shield/Desert Storm was the employment of 4,500 Global Positioning Systems[27] to aid in navigation in featureless desert terrain.

Even with all of this information technology, units deployed to Desert Shield/Desert Storm still experienced some of the same problems units experienced at the Combat Training Centers. Information overload was an issue for

some unit TOCs. Even though units had the computer technology to facilitate the analysis of raw data for many of the planning functions, the abundance of information was too much for commanders and staffs to assimilate. One aviation brigade reported that their S-3 section was as large as a division G-3, in order to handle all the information and mission requirements.[28] TOCs were forced to confine their attention to particular forms of information. As a result, blind spots developed. An information trend developed in battle damage assessment during the war. Units relied heavily on imagery of battle damage and neglected intelligence received from enemy prisoners of war. A picture or image provides concrete proof of damage. What a picture or image cannot convey is enemy morale. Intelligence received from enemy prisoners of war required additional analysis and probably would have provided commanders information on enemy morale. If this intelligence had been taken into account, U.S. forces would have known that the Iraqi's were worse off then the imagery indicated.[29]

Several comments made in Desert Storm Challenges: An Overview of Desert Storm Survey Responses indicate that at the brigade level there was no analysis done on the intelligence received from higher.[30] It was simply passed down to the battalions. This can be attributed in part to

the limited size of a brigade S-2 section. One aviation brigade augmented its S-2 section with four well-trained personnel and still had problems processing and disseminating information from division and corps intelligence summaries to subordinate units.[31]

The production and dissemination of the air tasking order demonstrates information management issues in Desert Shield/Desert Storm. Computer technology greatly facilitated the production of the daily order, consisting of approximately a thousand pages.[32] Unfortunately, those staffs that used the air tasking order were unable to read the entire order to determine what other missions were occurring in the same area of operations which might effect their own plans. Furthermore due to the size of the air tasking order, there was no easy way to transmit the information to all the units affected by it. The air tasking order had to be disseminated via floppy disk or paper copy. This greatly hindered the timeliness of the information.

Another information problem experienced during Desert Shield/Desert Storm was ensuring that critical information was distributed to the correct units. Due to the large scale nature of the operation, it was difficult for anyone to know what units would benefit from a particular piece of information. Information did not flow along a traditional

chain of command but flowed horizontally and vertically. Units created redundant databases and transmitted redundant or conflicting information. This in turn contributed to the information overload problems. Battle damage assessment information did not flow to the tactical commander in a timely manner for him to accurately assess his enemy. "Templated enemy units remained loosely confirmed or denied, and usually without accurate combat strength estimates."[33]

Once the ground phase of Desert Shield/Desert Storm commenced, timeliness and accuracy of information on enemy and friendly forces degraded. In part, this problem can be attributed to the large distances involved and the limitations of communications equipment. Brigades and battalions lacked specific detail on enemy deposition, strength, and activity. Intelligence from higher headquarters provided the "big picture" but lacked sufficient detail at the tactical level. Intelligence from higher headquarters was reported to be slow[34] and too out-dated to be of use during mission execution.[35] Tracking of organic units generally was not a problem. Tracking of flank units was difficult at battalion and brigade level.[36]

Even with the aid of technology and the right information, the commander and his staff must rely to a certain extent on intuition. During Desert Shield/Desert Storm, VII Corps employed a decision support system called

HAWKEYE to facilitate electronic warfare targeting and collection management during the operation. The HAWKEYE relies on explicit rules or templates[37] and does not factor in the possibility of an irrational enemy. Commanders must not rely too heavily on technological decision-makers and understand their limitations.

Crosstalk among battle staff sections in the TOC and among adjacent units was lacking during the ground phase of Desert Shield/Desert Storm. In the TOC to get an accurate picture of the friendly situation in the close battle, input was required from all battlefield operating systems and subsequent analysis of the information. Due to the fast paced operation, this crosstalk did not always occur. There was not one focal point for the commander to go and get an accurate and up-to-date picture of the battlefield. Due to distances involved and communications limitations during Desert Shield/Desert Storm, crosstalk between adjacent units was limited. It was difficult for commanders and TOCs to have an accurate situational awareness without information from the flanks.[38]

Both during Desert Shield/Desert Storm and Operation JOINT ENDEAVOR, the lack of trained users in the available technology was noted. Users did not fully understand the capabilities and limitations of the technological systems available to them. The lack of training ultimately hindered

productivity and slowed the staff process. Much of the time, users were trying to determine how to manipulate information. Furthermore, users did not know how to connect their computers into the overall network.

During Operation JOINT ENDEAVOR, flow of information is hindered by stovepipe systems. The Maneuver Control System (MCS) does not interface with the Combat Service Support system. Sharing of operational overlays and information and logistical information is hindered by the lack of connectivity. Again, the commander does not have one focal point to get an overall picture of the situation.

With the current systems in place, how do commanders get an overall picture of the battlefield? What processes or methods are in place to provide the commander with the information he needs?

Commander's Visualization and Information Processes

Information and battle command are inextricably linked. A commander must have information in order to command. Information is the means by which commanders execute their decision cycle. FM 100-6, Information Operations, outlines the commander's decision cycle as a continuous cyclic process consisting of four steps. By contrast, FM 101-5, Staff Organization and Operations, links the commander's

decision cycle with actions from his staff in the Deliberate Decision Making Process. Throughout the process of determining the optimal solution to accomplish the mission, staffs provide the commander with information to aid him in his decision making. In tactical situations, the decision making process is often carried out in an uncertain, dynamic environment, under conditions of high stress and friction. Information may be lacking or imperfect and lack of time could be a factor.

Once the mission is received from higher headquarters, the commander gathers relevant information about the battlespace, friendly forces, and enemy forces from his staff. The staff acquires this information from sensors, subordinate reports, intelligence reports from higher, study of the battlespace and their analysis of the mission as it pertains to their area of expertise. The commander assimilates this information, uses his judgment and experience to provide the staff a restated mission and planning guidance which includes his visualization of the future end state and his concept of how to execute the mission. The staff develops possible courses of action based on the commander's guidance, compares the developed courses of action and provides the commander with a recommendation. The commander makes a decision as to which course of action to proceed with. The staff develops a plan

to carry out the course of action and after the commander approves the plans, disseminates the plan to subordinate units. Once the plan goes into execution, the staff monitors the operation and provides an updated status to the commander. Future plans are modified based on the success and resources spent in the current plan. During this entire process, information is being exchanged and updated between the commander and his staff, among the staff elements, to subordinate commanders and to higher headquarters.

A commander's visualization of the battlefield or image and the staff's understanding of that image sets the stage for a commander's information requirements. A commander's image or his mental model of the current situation has approximately five to nine major factors associated with it. These factors are mostly based on mission, enemy, terrain, troops, and time available (METT-T).[39] The mental model that a commander develops through his analysis of METT-T needs to be of sufficient detail to make his decisions and as close to the reality of situation as possible. If the details necessary for decision making are not available, the commander will seek out this information from his staff, higher headquarters or from his subordinates.

A commander must successfully convey his mental model or image to his staff in order for his intent to be depicted in the courses of action to be developed and eventually the

plan that is produced. The need for this "shared vision" between the commander and staff is imperative for successful operations. How is understanding of the image achieved? Interaction and information exchange between the commander and staff aids in the understanding of the commander's image. The common background, experiences, doctrine (therefore a common terminology), as well as training the Army provides aids the staff in understanding the commander's image. The shared knowledge of the METT-T characteristics of the current situation can clarify a commander's mental model to his staff.

A commander's information needs are driven by his mental image of the battlefield and the staff's shared vision of this image. Requirements for information are based on the shared image. The meaning and value of information received are determined by how the information fits with the commander's image. If the staff does not fully understand the commander's image, then the wrong information will be sought and possibly time and resources wasted. Any information that is received is tested by the commander or the staff against the shared image. The commander constantly tests his image against reality, if information is received that invalidates his image, he must revise the image and convey his new image to his staff and subordinates. If needed, orders to subordinate units will

change to encompass the new image. Or he must obtain more information in order to revise his image. If the information received, verifies the commander's image then planning and execution of the plan can proceed. The commander must be able to detect any changes on the battlefield that conflicts with his image and react accordingly. How do commanders and staffs weed through the volumes of information available and get to the critical pieces of information?

To aid commanders in the acquisition of necessary information, the Army established a methodology for the commander to delineate the information they need for their decision making process. The commander's critical information requirements (CCIR), as determined by the commander with recommendations from his staff, are situation, mission and commander dependent. Various studies conducted in the 1980's attempted to identify a set of information elements which were critical to the commander's command and control decision making process.

In 1985, the Combined Arms Combat Development Activity (CACDA) at Fort Leavenworth, Kansas sponsored a study on CCIR. The study surveyed commanders in the field to determine if there was consensus on which information elements should be included in the CCIR. Upon collating the gathered data, the study conducted a General Officer Working

Group to discuss and verify the CCIR survey findings. The last step of the study, researched other works related to CCIR, compared findings, and identify possible oversights in their research. This study did not incorporate any empirical data from actual military operations, field exercises or command post exercises. The study did develop a baseline list of 25 information elements which should be included in the CCIR. The study recommends that these 25 elements should be available to the commander regardless of his positioning on the battlefield and that the CCIR must take priority in information exchanges. The study also recommends that the identified CCIR should be the basis for any decision aids or graphics developed for the commander. Furthermore, the command and control system should support the CCIR by giving those information elements information flow priorities, and automated storage, retrieval and update processes.[40]

In 1989, the Pacific Northwest Laboratory prepared for the Army Development and Employment Agency an empirical study of CCIR at brigade level.[41] The study identified a brigade commander's CCIR and established a pattern of the information flow between the commander and staff elements. The study looked at the content of information by battlefield operating system and evaluated information flow based on effects of the operation (defense or attack),

content of information, and direction of information flow. After the command post exercise was completed, the study surveyed the participating primary staff officers, their assistants and the commander on the criticality and perishability rating for each information element identified.

The results of the study were not very surprising. It confirmed what was already surmised about information flow at a tactical TOC. Primarily, the commander's interaction with his staff related to their area of expertise or battlefield operating system. As expected, the majority of his communications were with the S-3, regarding maneuver, the S-2, reference intelligence on the enemy, and the fire support officer concerning priority of fires and artillery unit status. The study also demonstrated that the commander exchanged information about maneuver and intelligence with others (not identified) outside of his staff. The information flow among staff members indicated coordination among the battlefield operating systems. Lastly, the study showed a positive correlation between what the commander and staff considered critical and perishable information elements and the frequency of exchange of the information elements.[42]

A comparison of the information elements identified as critical for decision making and operations by the two

studies reveals many similarities (Appendix A). Differences can be attributed to the methods of the two studies. The CACDA study surveyed commanders and the Pacific Northwest Laboratory study collected actual information data from a brigade command post exercise. Basically, a commander needs information which is accurate, relevant, timely, usable, complete and a correct level of detail for his decision making process. In the complex and uncertain environment of combat, what are the methods of information exchange to ensure a commander gets the critical information he needs?

A Rand Study, Understanding Commanders' Information Needs, conducted for the Army in 1989, identifies three modes of information processing that supports the commander's image of the battlefield. These three modes are pipeline, alarm and tree.[43]

The pipeline mode of information as its name suggests is a large transmission of information usually one way that is in a set format. Examples of pipeline information are logistics reports, daily personnel updates, and other daily standardized reports submitted in accordance with standard operating procedures. Mission analysis, course of action, decision and daily update briefings given to a commander by his staff can also be considered a pipeline mode of information exchange. Information presented in the pipeline mode is generally an aggregate of information from

subordinates. Pipelines are not suited for transmitting critical information. Since pipeline information is generally transmitted at a set time, critical information may be outdated by the time it is transmitted. Critical information may not fit into the format established for the pipeline. Or if the piece of critical information is included with the pipeline information it may not be recognized as critical and therefore overlooked. The pipeline mode is not suitable when the type of information required to make a decision is not known in advance. The pipeline is not interactive. If a decision maker requires more information of a specific type, the pipeline cannot provide it.

The alarm mode as its name suggests sends key information as quickly as possible when certain events, some determined in advance, occur or "trigger" the alarm. Once the event happens, the alarm is triggered and the information is sent as soon as possible. The commander receives the information and decides whether any action or further decision is needed. Once the event that triggered the alarm has been dealt with, the alarm gets reset to be ready for another triggering event. In order to accomplish a commander's concept of the operations or his vision, alarms are necessary to detect significant or critical changes in either the friendly or enemy situation.

Criterion for alarms can be determined directly by the commander or they can be inherently set by the shared military experience of the commander and staff. A commander can determine information requirements or conditions on the battlefield which will invalidate his image. If such an event occurs, he expects to be notified as soon as possible after the alarm is triggered. Some alarms are implicit by virtue of the shared military experience. If an event occurs which departs significantly from what was anticipated, an experienced staff would alert the commander to the new conditions on the battlefield. One of the main problems of the alarm mode is the identification of an alarm triggering event. The alarm mode requires the staff to completely understand the commander's image. Only with this complete understanding, can a staff recognize the implications that a piece of information may have on the commander's image. Without this shared image, a staff might not recognize the significance to the current situation as the commander views it. Normally, once a staff realizes an alarm has been triggered, getting the pertinent information to the commander is usually accomplished quickly.

The tree mode of information exchange is the most interactive of the three modes. The decision maker or the commander makes a request or demand on the information system and pulls the information from it. The commander

determines what information he will receive. It is not a supply-push system. The commander's request for information can be dependent on the current situation, his image of the battlefield, his experience or frame of reference, alarms which have been triggered and any prior requests for information. The tree mode is necessary when the volume of possible pertinent information is so great that it can't be presented in the pipeline mode. The commander's "directed telescope" is an example of the tree mode of information.[4:1] A pure tree mode of information exchange is difficult to implement by staffs or on computers. Even the simplest of decisions can require many branches or limbs that the management of all possible information becomes unwieldy.

The three modes of information exchange are not overlapping processes. Each provides the commander with information which differs in application, function, timeliness, the amount of detail and the amount of uncertainty (see Table in Appendix B). A comprehensive command and control system will integrate the pipeline, alarm and tree modes of information exchange. The current situation will determine which mode is dominant at a particular time.

Current Digitization Initiatives and Their Impact

The integration of digital technology into the Army is an attempt to leverage technology to allow a smaller force synchronize all its combat systems through increased situational awareness in order to win decisively. Digitization or the application of information technology to gather, disseminate and make use of timely information throughout the battlefield, will allow commanders at all levels to sustain an accurate and up-to-date picture of the battlefield to support their decision-making cycle and the execution of operations. Eventually in a digitized force, all battlefield elements will be linked by computers. Information will be exchanged from computer to computer via an electronic web.[45] This information will then be displayed for use by soldiers and commanders. The use of voice communications via the radio or tactical telephone systems will be minimized. It has been estimated that a reinforced brigade could have more than 1200 computers.[46] In order to develop this digitized force, the Army has conducted several experiments to test the use of improved information technology or digitization.

Operation DESERT HAMMER VI, an exercise conducted in April 1994 at the National Training Center in Fort Irwin, California, pitted a partially digitized brigade from the 24th Infantry Division against the Opposing Force (OPFOR) regiment, a non-digitized force. The brigade from the 24th

Infantry Division had a fully digitized 1-70 Armor Battalion (Task Force 1-70), and two non-digitized infantry battalions (one mechanized and one light).[47] The brigade also received direct support from digitally enhanced aviation, intelligence and reconnaissance systems.

Task Force 1-70 had several digital enhancements to be tested and demonstrated. Task Force 1-70 was equipped with Enhanced Position Location Reporting System (EPLRS), a navigation and digital communications system. Its capabilities include overlay production and electronic mail with preformatted reports. Task Force 1-70 was also fielded with the Brigade and Below Command and Control System (B2C2) with functions similar to EPLRS. However, the two systems were not compatible and could not exchange information.[48] Additionally, all of the tanks and the Bradley Fighting Vehicles were equipped with the Intravehicular Information System (IVIS) which provided digital situational awareness to all vehicle commanders and the battalion commander via a small orange and black digital screen and keyboard.[49] The IVIS which interfaced with B2C2, disseminated intelligence, orders, graphical overlays, logistic information, and vehicle locations throughout the task force and brigade headquarters. Furthermore, IVIS aids in navigation of the vehicle and provides a computer to computer link of the

vehicle's laser range finder and the supporting artillery unit for immediate calls for fire.[50]

Aviation support for Task Force 1-70 consisted of Apache attack helicopters equipped with laser-guided Hellfire missiles and an integrated Forward-Looking Infrared (FLIR) night vision system, and Kiowa Warriors equipped with a laser designation for precision artillery strikes, FLIR night vision and a real-time video downlink back to the brigade headquarters. The Kiowa can laser range a target to get a twelve digit grid coordinate, digitally sends the information to the supporting artillery which then engages the target.[51]

The intelligence support and reconnaissance capabilities for the brigade and the task force was also significantly "digitized" and extremely robust for a brigade level exercise. The brigade was supported with the All-Source Analysis System (ASAS) to perform the intelligence collection and analysis functions. Two scout teams were equipped with video cameras which transmitted real-time imagery back to the headquarters. Unmanned Aerial Vehicles (UAVs) with FLIR also provided real time video. The brigade was also directly supported by TR-1, a tactical reconnaissance aircraft with photo-reconnaissance cameras and Side-Looking Airborne Radar (SLAR) and by the Joint Surveillance and Target Acquisition/Reconnaissance (JSTARS)

aircraft which could provide targets far behind enemy lines and digitally send the information to deep-strike weapon systems.[52]

How did this digitally enhanced brigade fair against the "World Class" OPFOR? Did the digital enhancements significantly improve the commander's situational awareness? Operation DESERT HAMMER VI demonstrated the "potential difference that Information-Age technology can make on the battlefield, but that potential has not yet been fully realized."[53] The bottom line is the digitally enhanced brigade did not perform significantly better than a non-digitized brigade against the OPFOR.[54]

Even though there were numerous digital systems available to the commander, the systems were not fully integrated with each other and could not share information between systems. This is analogous to lack of cross talk between staff sections in a TOC. So even though ASAS provided the S2 national intelligence products at the TOC, the S2 had to resort to manual means to disseminate this information to the task force.[55] The intelligence received from the ASAS was not linked with the display on IVIS. Intelligence imagery and reports could not be sent from ASAS to the commander in his IVIS equipped vehicle. In order for the enemy to be displayed on IVIS, an enemy vehicle had to be lased and designated as the enemy by a friendly Bradley

or tank. So enemy battle tracking was limited to what friendly forces could see or line of sight. The lack of interoperability also increased instead of decreased the workload for some soldiers. As a result battle command is not enhanced. Three types of overlays had to be produced to disseminate friendly graphics to the task force. Two different types of digital overlays were produced as well as the traditional acetate graphics.

The IVIS, a tool to improve a commander's vision of the battlefield, did not provide the commander with complete situational awareness. As mentioned above, the enemy battle tracking depended on individual friendly vehicles identifying the enemy. Due to limitations of the IVIS not all vehicles could be displayed on the task force commander's IVIS. A task force commander could only see vehicles operating on his net (limited to 27)[56] and due to software shortfalls, positions reported in IVIS could be inaccurate. Furthermore, there was no way of determining whether someone had dropped out of the net or became digitally inactive or if they were receiving digital traffic. The new digital equipment did not provide the commander battle tracking of his scouts (they are not equipped with IVIS), of units on his flanks, of combat service support elements in his own task force or of higher headquarters elements working in his area of operations.

The digital technology did not provide the commander a means to improve his situational awareness. He cannot connect to the neighboring task forces IVIS net to gain knowledge of their situation. Battle tracking of friendly and enemy minefield locations is not yet digitized. Friendly employed minefields must be annotated on a map overlay as they currently are today. In order to be displayed on IVIS a separate digital overlay must be built.

During Operation DESERT HAMMER VI, the brigade TOC became overwhelmed with information. The National Training Center observer/controllers of Operation DESERT HAMMER VI identified that digital systems will increase the quantity of information available.[57] During the final After Action Review, the brigade S2 commented he "was overwhelmed with information...like drinking from a firehose."[58] He was unable to conduct thorough analysis of all the information he received in such a short time. He could not distinguish between what was real and what was not. The OPFOR conducted an elaborate deception plan which caused TF 1-70 to attack a dummy staging area thereby wasting resources. The task force contained 33 vehicles (M1A2 tanks, IVIS equipped Bradley and FIST-Vs) which could digitally call for fire.[59] This was a significant increase of potential observers over a non-digitized force. The fire support officer quickly became swamped with calls for fire. During Operation DESERT

HAMMER VI, the fire support officer received 11 calls for fire within three minutes.[60] Without procedures for fire support management and an understanding of the commander's priorities for fire support, the responsiveness and the value of indirect fire in support of the mission may be diminished.

An over reliance on technology cause TF 1-70 some problems during Operation DESERT HAMMER VI. Colonel Simmeth, the OPFOR commander studied the capabilities of the task force and its commander. He developed a deception plan to intentionally overload the TF commander with some true and some false information. His intent was to cause the task force staff to spend a lot of time determining what was true and what was false and cause the TF 1-70 commander to doubt his intelligence systems.[61] During hours of darkness, the OPFOR commander moved his tank task force and employed dummy tanks with heat source in its place to fool the task forces intelligence systems into determining that the tank task force had not moved. TF 1-70 relied on the imagery received and did not confirm the location of the OPFOR tank task force with human intelligence. The deception plan worked. TF 1-70 attacked the dummy staging area.

Fixation on a computer screen and total reliance on the incomplete information presented and not obtaining local situational awareness by looking outside of a vehicle was

also a problem experienced during Operation DESERT HAMMER VI. The IVIS screen in the tank or the Bradley is positioned so that the vehicle commander can either look at the computer screen or look outside of the vehicle but not both at the same time. A platoon leader was so fixated on his IVIS display which did not provide him enemy locations that he failed to look outside of his vehicle and navigated his platoon right into the OPFOR's engagement area.[62] Reliance on technology imagery, not looking out of the tank.

Training on the use of the digital technology requires continued emphasis. Major O.T. Edwards, the S3 of TF 1-70 during Operation DESERT HAMMER VI, commented that digital skills are easily lost and soldiers would revert back to their comfort zones under stress. When a unit was in direct fire contact, they reverted to FM communications to make the report.[63] Soldiers and leaders must practice on the digital technology so that using the technology becomes automatic. Training on accomplishing the mission the old fashioned way still must be accomplished until digital systems become 100% reliable.

Even though the Mobile Strike Force represents a notional division-equivalent force, the Training and Doctrine Command experimentation with Force XXI issues can provide valuable insights into information processing at brigade and battalion levels. Every year Command and

General Staff College students participate in an end of year exercise called Prairie Warrior. The Mobile Strike Force (MSF), a force participating in the exercise, is "equipped" with weaponry of the future. It is designed to exploit digitization and information technology. The student staffs (both division and brigades) are provided with digitized tools and observed using these tools during the course[64] and during the final exercise, Prairie Warrior.

One tool tested during Prairie Warrior was the Phoenix system, a battle command decision support system.[65] The Phoenix system was basically an updated version of the Maneuver Control System and provided the staffs with digital mapping, a graphics package to develop overlays, database management system, electronic mail, and video teleconferencing.[66] The Phoenix system was used to develop the relevant common picture (RCP) of the commander's battlespace.

The relevant common picture is an integrated portion of all the information available and graphically displays the enemy and friendly situation and commander selected statuses. This RCP could be transmitted to subordinate units. A dedicated team built or drew the RCP from information received from the staff and subordinate units. Usually a new RCP was built or updated every two hours. So even though this tool greatly improved battle tracking and

situational awareness over current methods, timeliness of the information was often lacking.

Electronic mail (e-mail) was a primary means of communications between the staff members and subordinate units. During offensive operations over 1500 e-mail message were sent. Many of these messages went unread and unopened or were simply deleted.[67] A message was sent does not necessarily mean the information was received in a timely manner if at all by the appropriate person.

Students surveyed after the exercise determined that decision making skills required of a commander were difficult to acquire in the knowledge-based environment of the Mobile Strike Force. Students made this assessment based on the "realization of the information overload that will occur in this type of environment."[68] The experiments during Prairie Warrior demonstrated that the alarms built into the systems to lessen the effects of information overload were extremely beneficial to the students and very necessary during operations when information began to pour in.[69] The experiment also showed that the use of graphic reports aided in the battle tracking and situational awareness of the staff and subordinates. The graphics were able to provide a large volume of information on a single display, the brigades could use the graphics to aid in synchronization of planning and execution and since all

units had the same graphic display coordination was facilitated.[70]

Conclusions

The introduction of increased digitization and technology into today's Army currently is not alleviating the information problems experienced by brigades and battalions. In fact one could claim that the new technology is exacerbating information management problems at the tactical level. Increased digitization and technology is estimated to have increased the volume of data 600 percent.[71]

Task Force 1-70 experienced many of the same information problems that other units going through a NTC rotation experience. These problems include battle tracking of friendly and enemy situation, cross talk among staff elements and subordinate units, analysis of information; determining the "so what" of information, and the heavy reliance on information supplied by technology and not confirming it with human intelligence. As Colonel Simmeth the commander of the OPFOR at NTC stated, "Being able to see everything I was doing, and being able to know what one is looking at are two radically different things."[72]

The majority of the current digitization initiatives seem to provide the commander and staffs with the pipeline mode of information processing albeit at a higher rate of reporting. Depending on the protocols of the software, friendly vehicle location information provided by the IVIS, for example, can be updated automatically every 15 minutes. Like the Mobile Strike Force, an alarm mode of information processing needs to be built into the new technology so that critical information is not overlooked and is immediately brought to the attention of the decision maker. Critical information cannot be contained in a normal e-mail message that does not get read or is deleted. Whatever method of prioritization is used for ensuring critical information gets through cannot be abused and must be strictly enforced (not all messages are urgent). Current digital initiatives are not integrated to the extent that a commander can query one source to obtain information on all aspects of the friendly situation and enemy situation. Once these technologies become fully integrated, sharing database information vertically and horizontally, then the commander will have at his fingertips the ultimate in tree mode of information processing.

Increased digitization of the force does not negate the requirement for the commander to visualize the battlefield and his need to share his mental model with his staff and

subordinates. Perhaps more so now with the increased dispersion on the battlefield and increased quantities of information available, staffs and subordinates must fully understand the commander's intent. The tailoring of the Commander's Critical Information Requirements (CCIR) for a given situation is imperative. With a potential increase of data at 600 percent, establishment of CCIR, a means to establish the priority of information to the commander, is vital to ensure the commander gets the information he needs for a particular situation.

Technology and digitization of a force do not fight and win the nations wars, people do. With all the fervor and hype over how technology will give the Army information dominance over our opponents and lessen the uncertainty on the battlefield, one must remember that commanders and soldiers, human beings, are still the backbone of the Army. Technology must be viewed as only a tool to make human beings jobs easier. Humans still make the decisions. Machines do not. If technology is not easy to use or makes a task faster or simpler, when technology becomes too cumbersome, soldiers under stress will revert back to their comfort zones and not use the technology. Technology should not provide so much information that it paralyzes or slows down the commander's decision making process.

Commanders cannot let technology take the art out of battle command. Face to face meetings with subordinate commanders and a commander's presence on the battlefield are still required for the moral domain of battle. Digitization of reports and orders has lessened the requirement of voice communication over the FM radios. This is a mistake. Commanders and subordinates, both, need to hear the inflection and tone of voice, whether stressed or calm and reassuring. A message on a computer screen cannot convey the same meaning as a familiar voice. As Martin van Creveld states in Command in War, to let technology determine the purpose of command systems is not only to become a slave of technology but to forget what truly constitutes command.[73]

Appendix A

CACDA Study[74]

Assets available
Command mission
Concept (Scheme)
Task Organization
Avenues of Approach
Adjacent unit
Enemy activity
Friendly activity
Battlefield geometry
Enemy situation
Command/G2 guidance
Critical terrain
Enemy mission
Intelligence summary
Release policy
Command controlled items
Friendly unit information
Critical situation alert
Area of operations
Enemy weapon systems
Axis of advance
RAD dose station
Assessment (Enemy)
Target criteria
Enemy aircraft

Pacific Northwest Study[75]

Enemy location
Concept
Friendly unit status
Friendly unit location
Enemy intentions
Enemy capabilities
Task organization
Priority of fires
IEW Status
Artillery unit
Enemy unit identification
Control measures
PIR responses
Brigade mission
Artillery task organization

Appendix B

CHARACTERISTICS OF THE THREE INFORMATION MODES[76]

MODE	APPLICATIONS	FUNCTIONS	TIMELINESS	DETAIL	UNCERTAINTY
Pipeline	- For "normal" operations - When the commander believes the image is valid - For continuation of the plan	- To ensure that staff & subordinates share the commander's image - To check the validity of the image	- According to schedule	- Aggregated (typically two levels down)	- Moderate
Alarm	- For "normal" operations - When the commander believes the image is valid - Between regular information conveyance times	- To alert the commander to a possible violation of image - To alert the commander to a possible transition to tree mode	- Immediate	--Highly detailed, highly focused	- Likely to be very high
Tree	- When the image is broken -When a new plan is being constructed	- To repair and reconstruct the image - To begin a new plan	- Varies with item and situation	- Selected use of "telescope"	- Likely to concentrate on lower-uncertainty items

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